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PLASTICIZED FILMS FROM ZEIN

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METHODS USED IN PREPARING UNSUPPORTED PLASTICIZED ZEIN FILMS

As zein films and coatings are all obtained by evaporation of the organic solvents, it is essential that the casting surface be very smooth and level and that the films be prepared as dust-free as possible. We have found that highly polished chromium plates are the most satisfactory.

UNTREATED ZEIN FILMS

For untreated plasticized zein films, 20 grams of the protein is dissolved in 100 cc. of 85 or 90 percent ethyl alcohol and 15-18 grams of the dimer acid (see note at end) is added after the solution clears. Slight warming aids in rapid solution of both the zein and the dimer acid, but it is not essential. Coatings which are spread with a doctor blade set at .015-.020 inch will yield dry films of approximately .0025 inch thickness. After air-drying for 1 to 2 hours the films can be easily stripped from the chromium plates. They can be further dried on sheets of paper or hung upon a rack for further conditioning and testing.

CURED BLUSH-PROOF FILMS

The following procedure has been used for the preparation of aldehyde-cured blush-proof zein films: Twenty grams of zein are dissolved in a mixture of 90 cc. of 95 percent ethyl alcohol containing 10 cc. of formalin (37.7 percent CH_2O) and 1 cc. of 1 N HCL is added as a catalyst. After solution of the zein, the dimer acid is added and the entire solution heated under pressure (autoclaved) at 15-20 pounds steam pressure for 15 to 30 minutes. After cooling, the solution is ready for use as a coating or a film-forming material.

In making a series of plasticizer tests, a stock solution of the autoclaved aldehyde-treated zein can be prepared without addition of dimer acid, as such solutions are quite stable. The different plasticizer mixes are then added to this solution as they are needed. In autoclaving small samples, heavy-glass soft-drink bottles serve very nicely as pressure flasks. They can be sealed easily with the usual crown-cork crimp seal which will stand pressures greater than the glass containers. In order to obtain complete blush-proof zein coatings and films prepared from this autoclaved solution, the dried coating or film must be subjected to an elevated temperature, which is accomplished by heating for 10-20 minutes at 120-130° C. in a forced-draft air oven. Completely cured zein films made by this method will not blush on immersion in water, and even after long immersion will show no loss in weight when dried to previous standard conditions. These cured films will absorb less than 10 percent moisture, while the uncured zein films will absorb approximately their own weight of water. It is obvious that a great number of

changes and modifications can be made to suit the particular requirements of the individual operator. Solvents other than aqueous ethyl alcohol can be used; aqueous acetone solutions have lower viscosities than the alcoholic solutions and will thus give better penetration. Solvents having very high evaporation rates, as mixtures of methyl alcohol and chloroform or methyl alcohol and benzene, may find specialty uses, as in glues, etc. Nitroparaffin and alcohol mixtures also offer a wide range of properties for the selection of a zein solvent. Likewise, leveling solvents can be added to overcome orange-peel appearance, or completely anhydrous solvents can be used to allow incorporation of other plasticizers and resins.

The following data will indicate some of the properties of dimer acid-plasticized zein films:

Percent Dimer on Weight of Zein	Tensile Strength Lbs./Sq. In.	Percent Elongation
60*	3,430	27
70*	2,780	36
80*	2,500	116
90*	2,720	136
80	2,870	43
90	2,830	92
	Water Adsorption	Loss on Soaking
80	11	0
90	11.7	0

*Hydrogenated dimer acid.

Vapor Transmission - Calculated in grams per day per square foot and to a thickness of .01 inch

	Per day per sq. ft.	Actual loss and thickness of film	
	Gr.	Gr./day	Inch
70	1.19	0.110	0.0037
	1.25	.109	.0039
80	1.26	.088	.0049
	1.24	.106	.0040
90	1.00	.110	.0031
	.99	.109	.0031
	.85	.048	.0060
	.78	.040	.0066
Blank, no plasticizer	3.69	.465	.0027
	4.09	.482	.0029
	3.92	.446	.0030

Note: Dimer acid refers to residual dimerized fat acids obtained from the polymerization of esters of fat acids found in drying and semidrying oils.

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